

Topic A


"The Visible Sky"

Part 5. Moon's Motion

(Web Version: 01-22-01)

1

Ready for the Moon?

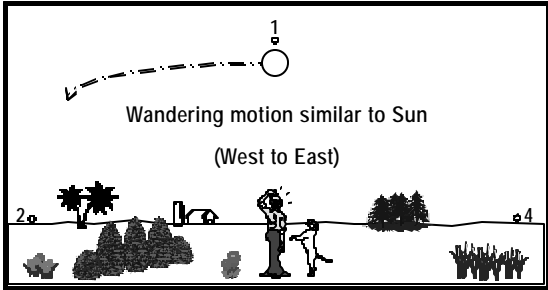


- Moon's motion similar to Sun
- A major difference — *rate* (time for one trip around)

but complication — *phases!*

2

Moon's Motion

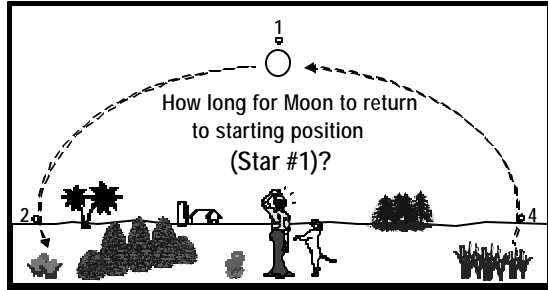


Wandering motion similar to Sun
(West to East)

East Horizon Facing South West Horizon

3

Question

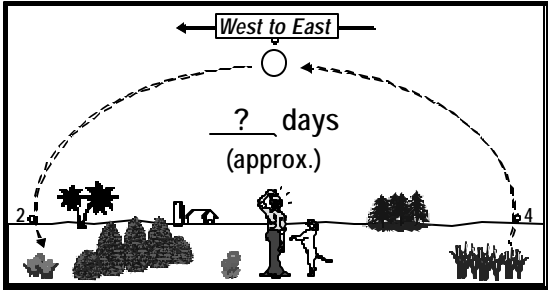


How long for Moon to return
to starting position
(Star #1)?

East Horizon Facing South West Horizon

4

Answer



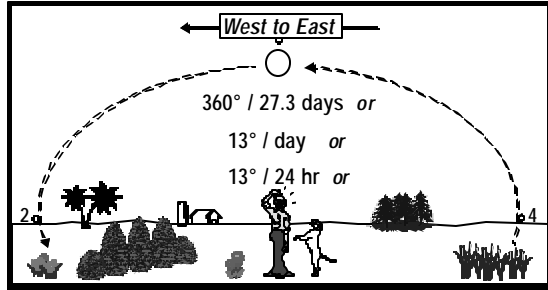
← West to East →

? days
(approx.)

East Horizon Facing South West Horizon

5

Moon's Rate



← West to East →

360° / 27.3 days or
13° / day or
13° / 24 hr or

East Horizon Facing South West Horizon

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Moon's Rate

East Horizon Facing South West Horizon

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Remember . . .

- Moon's apparent or angular size?

Answer: About one-half degree

- How many Lunar diameters per hour is the Moon's motion?

Answer: ? diameter per *hour*!

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Observe The Moon

- Note position of Moon near a bright star

Observe Moon again after an hour or so

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Observe The Moon

- Note position of Moon near a bright star

Observe Moon again after an hour or so

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"The Moon Rides Too"

The Moon ("Moony") also rides

"Moony" is broke
"Moony" has no money . . .
so she runs from "Sonny" who wants her ticket!

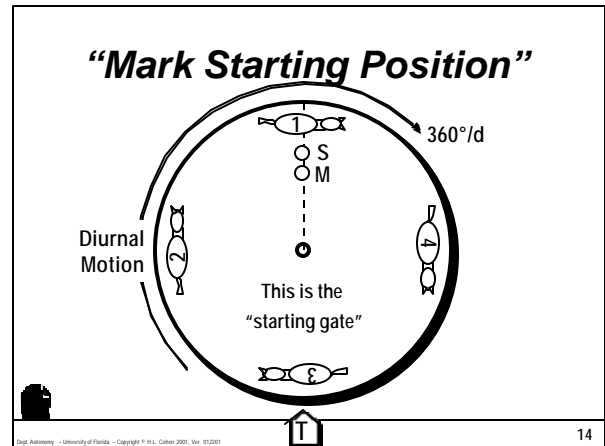
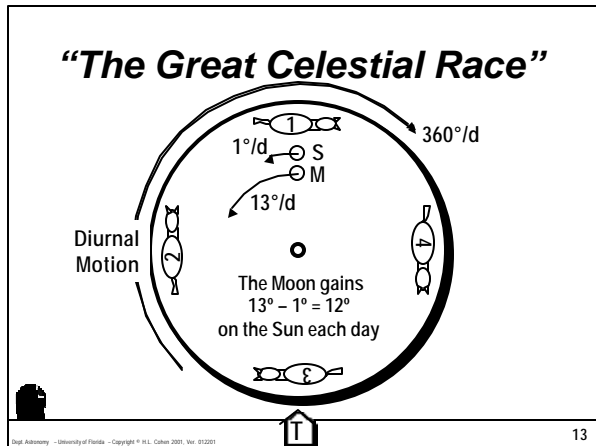
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"No Problem!"

"Moony" can run faster than "Sonny"!

The Moon runs 13x faster than the Sun

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First: Some Terminology*

- Elongation *Angle* between two objects
- Aspect *Configuration* of two objects
 (“relative positions”)

*See Study Guide Table 3

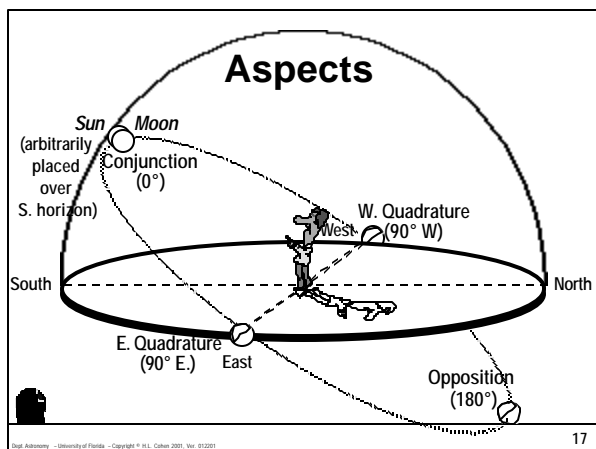
15

Aspects & Elongations*

Aspect	Elongation	Meaning
Conjunction	0°	“together”
Quadrature	90° (E or W)	“quarter”
Opposition	180°	“opposite”

*See Study Guide Table 3

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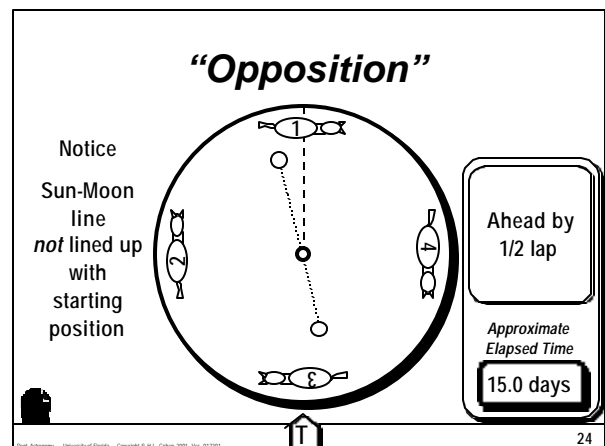
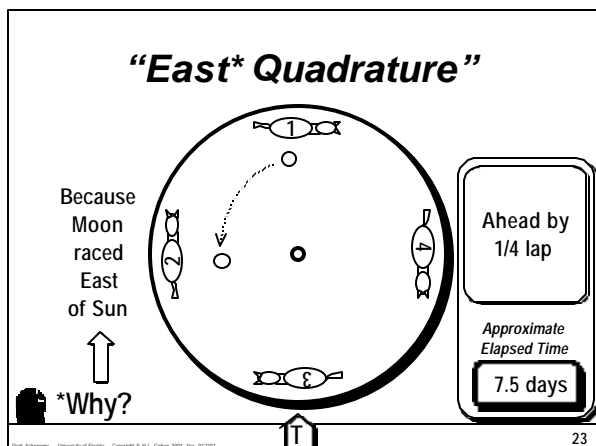
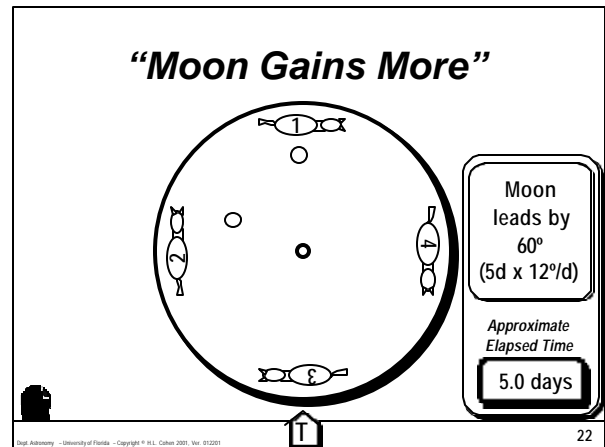
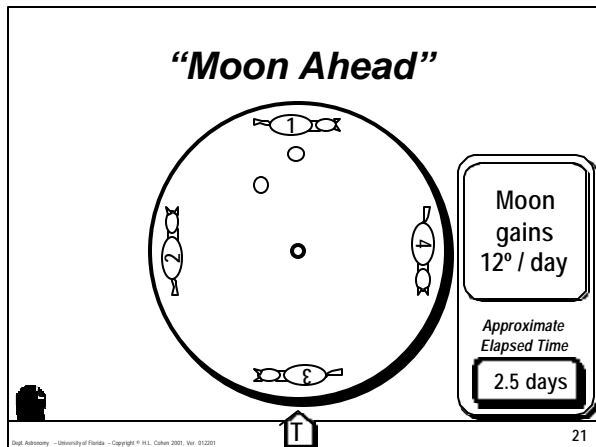
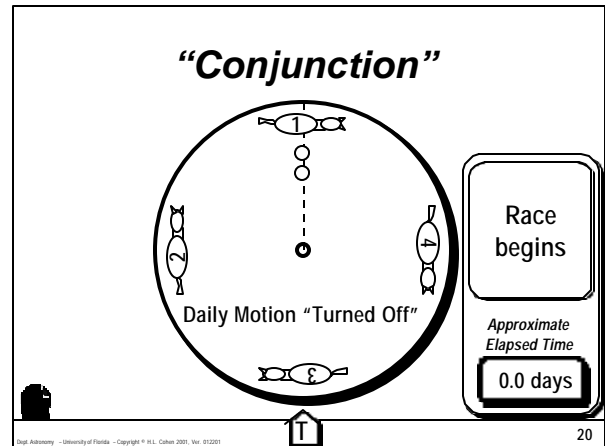
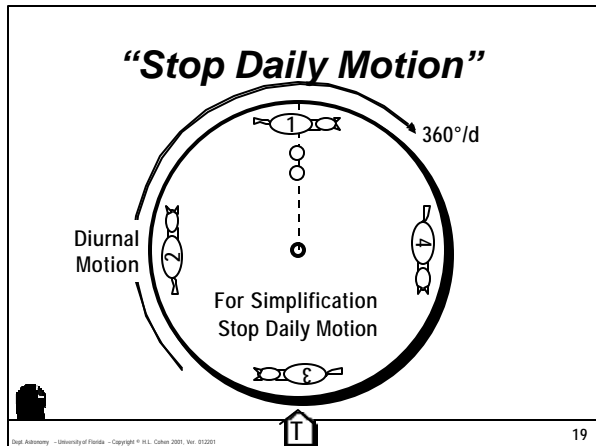


Moon’s Motion Summary

See Study Guide (Table 2)

• Alternate Names	“Monthly”
• Objects	Moon
• Direction	West to East
• Average Rate	$360^\circ / 27.3 \text{ days} = 13^\circ / \text{day}$ (1 lunar diameter/hour)
• Greatest Elongation	180° (opposition)

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“West* Quadrature”

Ahead by
3/4 lap

Approximate
Elapsed Time

22.5 days

***Why?**

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“Moon Back at Starting Gate”

How long
to run track
once?

Approximate
Elapsed Time

? days

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“The Sidereal Period”

Time to
return to
“fixed star”

Approximate
Elapsed Time

27.3 days

27

“The Synodic Period”

Time to
lap Sun!

Approximate
Elapsed Time

29.5 days

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Two Lunar Periods

<i>Sidereal</i>	27.3 days (approx.)
<i>Synodic</i>	29.5 days (approx.)

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Sidereal Period

Length 27.3 days (approx.)

Time to . . .

- Complete *one circuit* of race course or
- Return to *same star*

(*Sidereal* means “star” — a “fixed point”)

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Synodic Period

Length 29.5 days (approx.)

Time to . . .

- Gain 360° on Sun or
- Gain *one lap* on Sun or
- Return to *new meeting* (conjunction) with Sun

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Synodic

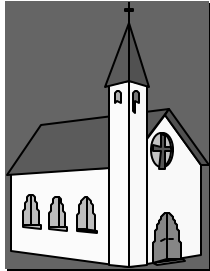
- What does *synodic* mean?
(That is — what is a *synod* ?)
- Notice prefix *syn*
- Notice many other words have this prefix

• synagogue	• synergy	• syntax
• synchronous	• synonym	• synthetic
• syndrome	• synopsis	• etc.

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Hint

Synod
relates to the church
but spelling is
syn not sin!

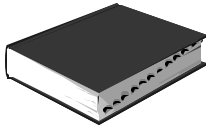


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Find Meaning of Synod

Use a good dictionary!

Meaning of *synod*
shows why
lunar 29½ day cycle
called
the *synodic period*

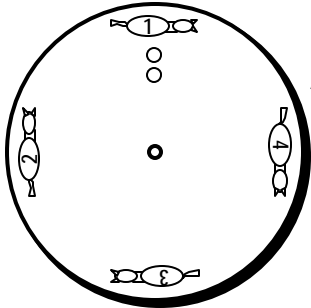


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“The Race Reviewed”

Problem?

“Moony”
has no
money.

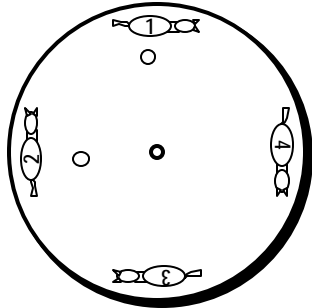


Solution

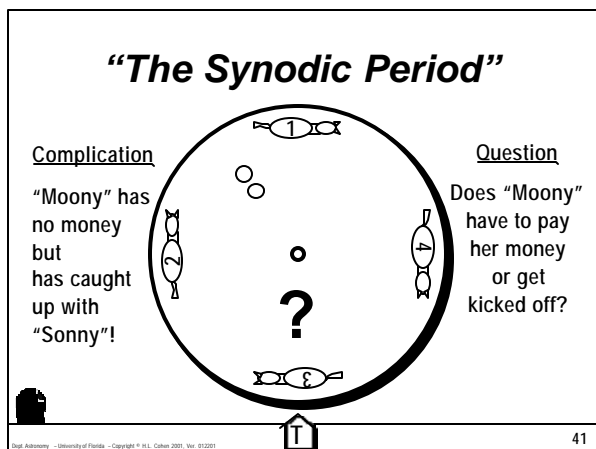
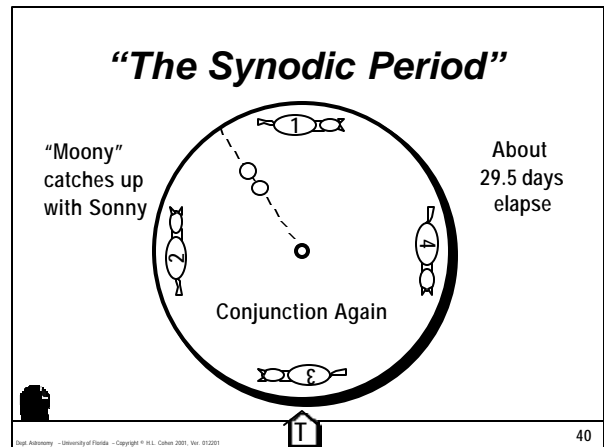
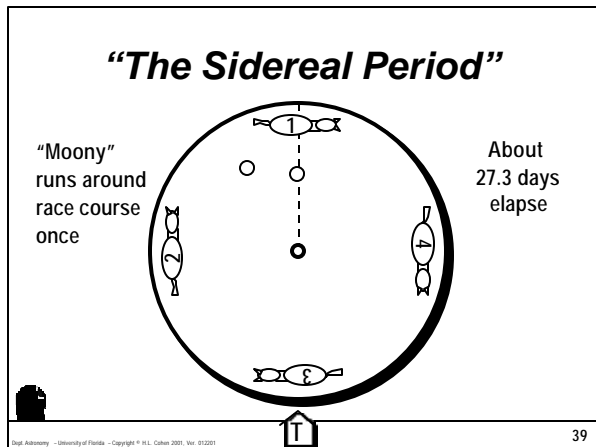
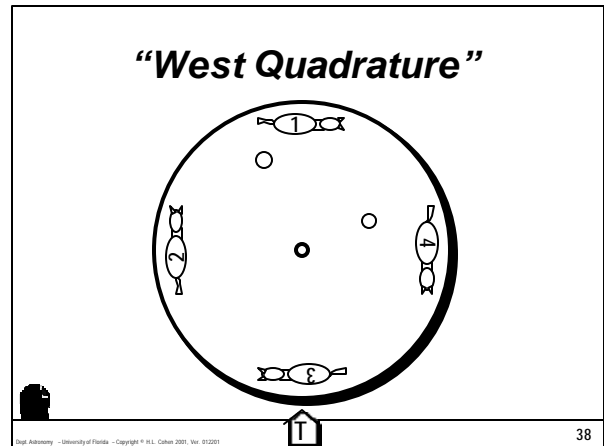
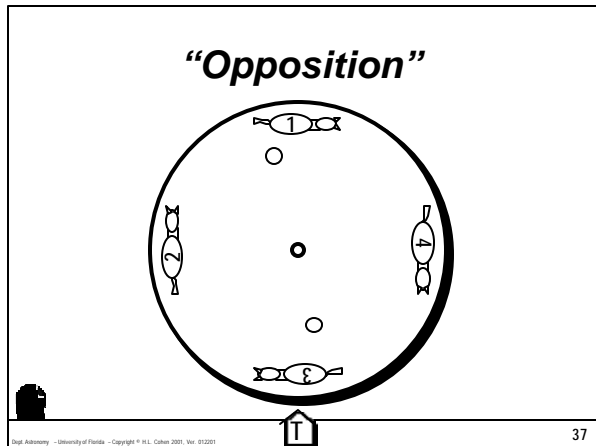
“Moony” runs
away from
“Sonny”!

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“East Quadrature”



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- ### Answer from Lunar Phases*
- Moon wanders and *phases*
 - Key — *phases & aspects related*
 - Phase *Appearance of Moon's shape*
 - Terms
 - Wax First half of cycle
 - Wane Last half of cycle
- *See Study Guide Table 3
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The Moon's Phases*

The diagram shows two rows of moon phases. The top row is labeled "Waxing Phases" and includes New, Crescent, First Quarter, and Gibbous. The bottom row is labeled "Waning Phases" and includes Full, Gibbous, Third Quarter (or Last), and Crescent. A dashed arrow indicates the progression from New to Full and back to New.

*See Study Guide Table 3

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The Moon's Phases

The diagram shows two rows of moon phases with corresponding time intervals. The top row includes 0d (New), 0 - 7½d (Crescent), 7½d (First Quarter), 7½ - 15d (Gibbous), and 15d (Full). The bottom row includes 15d (Full), 15 - 22½d (Gibbous), 22½d (Third Quarter (or Last)), 22½ - 30d (Crescent), and 30d* (New).

*Cycle time actually about 29½ days (Synodic Period)

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The Moon's Phases*

The diagram shows two rows of moon phases with aspect names. The top row includes Conjunction (New), East Quadrature (Crescent), Opposition (Full), and West Quadrature (Gibbous). The bottom row includes Opposition (Full), West Quadrature (Gibbous), Conjunction (New), and East Quadrature (Crescent).

*See Study Guide Table 3: Recall aspects mean position

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"New Moon"

The diagram shows the Earth and Moon in conjunction. The Moon is between the Earth and the Sun, so its illuminated side is facing away from Earth. Text: "The Moon ('Moony') is entirely concealed!"

Conjunction

Approximate Elapsed Time

0.0 days

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"Waxing Crescent"

The diagram shows the Earth and Moon in elongation east. The Moon is east of the Sun, so a small sliver of its illuminated side is visible from Earth. Text: "The Moon ('Moony') slowly begins to reveal herself!"

Elongation East

Approximate Elapsed Time

2.5 days

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"First Quarter"

The diagram shows the Earth and Moon in east quadrature. The Moon is 90 degrees east of the Sun, so half of its illuminated side is visible from Earth. Text: "The Moon ('Moony') is half revealed"

East Quadrature

Approximate Elapsed Time

7.5 days

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"Full Moon"

The Moon ("Moony") is fully revealed

Opposition

Approximate Elapsed Time

15.0 days

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"Last Quarter"

The Moon ("Moony") is going back into "disguise"

West Quadrature

Approximate Elapsed Time

22.5 days

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"Very Thin Crescent"

The Moon ("Moony") is almost completely concealed

One Sidereal Period

Approximate Elapsed Time

27.3 days

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"New Moon Again"

The Moon ("Moony") is again completely hidden

One Synodic Period

Approximate Elapsed Time

29.5 days

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Phases Not Arbitrary

Moon phases do *not occur by chance*

- Go hand-in-hand with *aspects*
- Each phase occurs when Moon has a *specific relation (position) with Sun*

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The Synodic Period

Both time to complete one

- One lap on Sun
(return to same relative position or aspect)
- and*
- One cycle of phases

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Notes On Moon's Phases*

What does gibbous mean?

Look up meaning of gibbous!

New Crescent Full Gibbous Full

Full Gibbous Third Quarter Crescent New
(or Last)

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The Crescent Moon

- Thin crescents show entire Moon
- Called *"old moon in new moon's arms"*
- Ancient Greeks thought illumination by a second, hidden heavenly "fire"!

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Crescent Moon Gallery

Early Evening

Early Morning

Early Morning

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See Study Guide Table 3 (bottom)

Crescent Moon Questions

- The "tip" or h ___ or c ___
- The "line between dark & light" or t _____
- The Moon's "tips" always point in what direction?
- The "edge" or l ___
- How many degrees long is the "arc" of the Crescent Moon?

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A Young Moon

1989 April 7
(20.6 hours old)

Taken From W. Side of Univ. Florida Campus
Near Present Site of SW Recreation Center
(Did not exist when picture taken)

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Astro Cycles

- Calendrical reckoning based on astro cycles
 - Day turn of the sky
 - Month cycle of lunar phases
 - Year motion of Sun around sky
- What major calendar unit omitted?

Answer . . . ____?

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The Week

- No astro cycle = 7 days
- Origin of week unknown
- Some possible explanations
 - 1) One quarter lunar cycle about one week
 - 2) Week based on the original 7 planets!

In fact, days of week named for the 7 planets

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Weekday Names

<u>English</u>	<u>German</u>	<u>French</u>	<u>Planet</u>	<u>Teutonic</u>
Sunday	Sonntag	Dimanche	Sun	Sun
Monday	Montag	Lundi	Moon	Moon
Tuesday	Dienstag	Mardi	Mars	Tyr
Wednesday	Mittwoch	Mercredi	Mercury	Woden
Thursday	Donnerstag	Jeudi	Jupiter	Thor
Friday	Freitag	Vendredi	Venus	Freyja
Saturday	Samstag <i>or</i> Sonnabend	Samedi	Saturn*	

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* Only day named for a Roman god

The Month

- Based on cycle of lunar *phases*
- How long is one lunar cycle?
(one *lunation*)

Answer: About 29½ days (±1/4 day approx.)

- Notice similarity: “month” & “moon”

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Many Words Related to Moon!

moon	meal	piecemeal
Monday	month	semester
meter	diameter	geometry
measure	dimension	immense
menses	menopause	menstruate

(Have context of marking time)

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The Lunar Cycle

- One lunar cycle = 29½ days (synodic period)

A lunar month = 29½ days “awkward”

- Solution . . .

Devise calendar with pairs of 29 & 30 day months

- Result — average month = 29½ days

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Lunar Calendar Arithmetic

• One lunar month	= 29 <i>or</i> 30 days
• Six 29 day months	= 174 days
• Six 30 day months	= <u>180 days</u>
• One lunar year	= 354 days (12 x 29.5)
• One solar year	= 365 days
• Deficit	= 11 days per year!

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